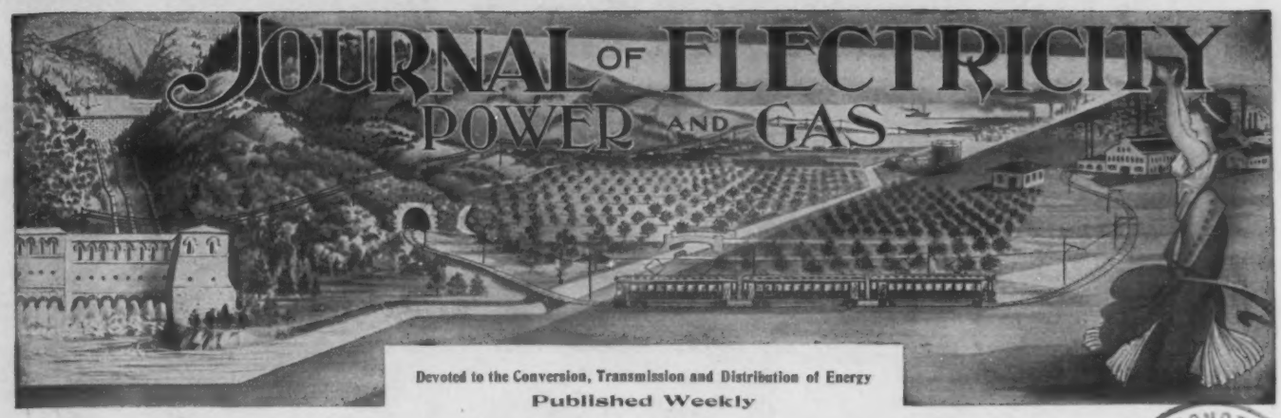
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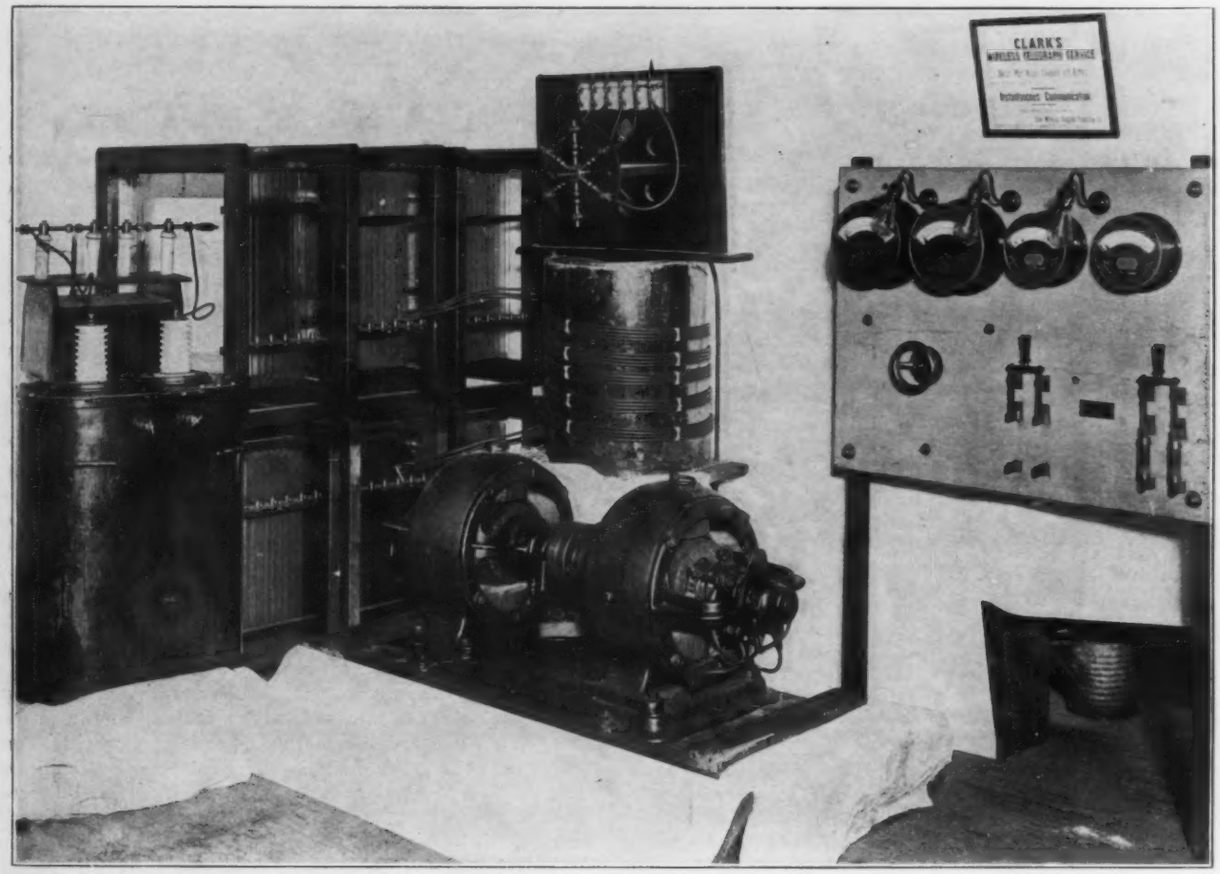
VOLUME XX. SAN FRANCISCO, CAL., MAY 30, 1908 No. 22

WIRELESS TELEGRAPH STATION AT THE SOO.

The electric equipment of the new wireless telegraph at the Soo, on the Great Lakes, includes a self-sustained ship's spar, 225 feet high, supported by four anchors of concrete cement of 12 tons each. This mast is guyed with four sets of ½-inch cables with four circuit breakers at each section, making 16 guys on the mast. The aerial capacity consists of 50 strands of special bronze wire, No. 6, B. & S. gauge stranded. These 50 strands are supported by a yoke yard-arm spread out 22 feet at the top. Each aerial wire is 450 feet long, terminating at the station multiple spark gap into groups of five wires each.



INTERIOR OF WIRELESS TELEGRAPH STATION AT THE SOO.

It is maintained that during the past season the Clark wireless system demonstrated to the marine interests of the Great Lakes the rapidity, accuracy and absolute reliability of the wireless telegraph service. It is held that with the opening of the Soo station this season another great stride will have been made towards the further usefulness of the wireless telegraph system in connection with the marine interests on the Great Lakes.

It is claimed that the Soo station will be one of the most complete wireless telegraph stations to be found anywhere in the world, and among the instruments and apparatus are devices which have not yet been introduced anywhere else. The station is manned by three operators—a chief operator and two subordinates. It is intended to divide the tricks into a nautical fashion of eight hours each. The most important part of the twenty-four hours will be in charge of the chief operator.

The electric equipment of the Soo station is 25 kilowatt capacity, and the electrical current and power to supply the transmitting generator set is taken from the water power company's mains at the Soo and brought into the station at a pressure of 500 volts. This connects direct to the controlling switch-board. From here the connections are led to the various parts of the controlling apparatus, which includes automatic motor, starter, voltmeters and ammeters and field control to regulate the speed of the generator set, all mounted on a polished marble switch-board. On the switch-board is also mounted the frequency indicators, including reactance regulators and automatic starter, so that the operator can control immediately at his right hand the full manipulation

of any part of the apparatus and tell by one glance at his recording instruments exactly what output and results he is obtaining from his apparatus and instruments.

It may be stated that the transmitting current enters the station at 500 volts, and is stepped up through 25-kilowatt oil insulated transformer to 80,000 volts. Shunted across the spark gap is the primary of the oscillating transformer connecting with 20 crates of oil insulator condensers. The top end of the secondary coil of the oscillating transformer being connected to the center terminal at the multiple aerial spark gap and the lower end or outer terminal of the oscillating transformer connects to the earth connection.

The latest receiving sets are provided for the receivers for the Soo station, considerable time having been devoted to the working out of a complete system of tuners which make this outfit a distinctive one, as it is not to be found on any other wireless telegraph station in the world, and it plays an important part in the accuracy and reliability of wireless communication. With this complete system of tuners, the Soo station will be able to get in communication with any other station or boats on the Great Lakes, and can also cut in or cut out any other station that would like to communicate with that station, no matter what the tune of these may be. In other words, the wireless tuner, installed at the Soo station, is arranged so that the operator can isolate and select the station with which he is desirous of communicating.

It is said that the tuner is arranged with a combination of inductance and capacity, by the adjustment of which the operator can inform himself of the various wave lengths of the different stations, and with the assistance of the tuner, the aerial wires of the receiving station can be made equal to that of a sending station, therefore, the receiving operator can tune up or tune down the scale of waves as the case may be, to get connection with any other station, or shut out other sending stations if he so desires.

A special design of head-telephones is provided for the operator, which are of the most sensitive type of work, in connection with the detector receiver circuit, and with the properly adjusted diaphragms the incoming impulses are rendered plainer and more audible to the receiving operator.

A system of interference coils are used to cut out the atmospheric static electricity, developed so as to isolate the station as much as possible, and, in fact, to have it as comparatively free from electrical interference as possible, which marks an important advance in the perfecting of the system for commercial work.

It was feared by many that the electrical impulses sent out by powerful stations would interfere with those of a feeble station, or of less power. It was also questioned whether interference could be rendered impossible or whether an operator could interfere with a competitor's messages.

It is claimed that the Clark wireless stations at Detroit, Port Huron, Buffalo, and Cleveland are in daily communication all day long, and at the same time there were a number of boats crossing Lake Erie carrying wireless apparatus, yet not a single message between these stations is readable on the steamers.

It is maintained that the problem of tuning and sychonizing has been practically solved, the receiving instruments are adjusted to respond to the frequencies of vibration and wave length of the other occupying a definite period, and all other waves than those for which the instruments are tuned are screened out. This may be illustrated by the action of the tuning forks by arranging the two tuning forks of the same sized tone, and pitched near each other. By striking No. 1 fork, tuning fork No. 2 is affected through the medium of the air, and responds audibly. This is what we call sympathetic resonance. But let No. 3 tuning fork, of a larger size than one in symphony with it be made to vibrate, whatever its proximity to No. 2, there will be no sound, for the radiator sending out the waves and the resonator receiving the waves must be equal in tune, or resonance will be impossible.

It is interesting to note that in the arrangement of the transmitting apparatus for ordinary messages, the Soo station is supplied with a special set of apparatus for communicating to a distance of 100 miles. When needed, the large power is brought into play, the high power apparatus having a maximum communication distance of from 500 to 1,000 miles, varying in wave lengths from 500 to 3,000 meters.

It is held that during the season of 1908, on the inland seas, messages will be sent direct into Cleveland, Buffalo, Detroit, Duluth, Chicago or Milwaukee from the Soo as easily as the Port Huron station sends messages into Cleveland or Buffalo. The value of the service can readily be seen, as the master of a boat can report on coming into locks or canal, and have a reply from the owner or manager before he is through the locks. This service cannot be rendered by the wire lines. The rapidity of the wireless telegraph service is without parallel. The wireless service on the Great Lakes is becoming indispensable to the vast shipping interests, and great success is assured with the present complete facilities and increased numbers of wireless stations now in operation.

COPPER MARKET SITUATION.

Copper is firmer and more active. Within the past few days there has been an increasing degree of strength manifest, and quotations for Electrolytic Wire Bars have advanced from 12⅜@12½ to 13 cents. Leading holders sold heavily during the last half of February for export at low prices, and since that time there has been considerable inquiry for domestic account with limited sales.

Europe has managed to maintain the most prominent position among the buyers of copper, and by securing important concessions the purchases by foreign interests have been in large volume. These transactions have relieved sellers here of great quantities of the metal, and as a matter of course domestic consumers are now confronted with much firmer conditions than was the case a few weeks ago.

There is some improvement in consumptive activity also, but although this is so, manufacturers are still intent on pursuing strictly conservative methods. It is encouraging, however, to note the gradual elimination of depressing conditions from business generally, and to see signs of well-directed efforts to re-establish normal conditions again in the industrial situation.

It is impossible to estimate just how long Europe will take to absorb the enormous exports from this country, amounting to over 168,000 tons since October 1. The resumption of production at the Amalgamated mines and the starting of operations at the Washoe smelter are factors of the first importance to the consumer. It will take an astonishing growth in consumption to prevent accumulation, and in the face of self-apparent facts it would be wise policy to encourage demand to the utmost by keeping the market on a reasonable basis. Inquiries from the American trade are more plentiful, and business has been closed at 13 cents with European buyers. Electrolytic has been advanced to 13 cents, and the market is stronger than for a considerable time.—"Copper Gossip."

DISCUSSION.

INDUCTIVE INTERFERENCE WITH TELEPHONE CIRCUITS IN PROXIMITY TO HIGH POTENTIAL TRANSMISSION LINES*

Mr. Hunt—Gentlemen, I am sure that we all appreciate very fully the paper which Mr. Miller has given us. A great many of us have experienced a great deal of trouble in the operation of telephone service of our own upon transmission lines, the wires being carried upon the same poles. Whether there are many of us who can discuss this matter as carefully as Mr. Miller, I doubt, but we have with us this evening a gentleman who is probably fully as competent to discuss it as any one in the country, and I would like to ask Mr. McMeen if he will come to the front and help us out a bit. I am very glad, Mr. McMeen, that you are able to be with us.

MR. S. G. McMEEN.

Mr. Miller's paper has appealed to me as being a timely and most important contribution to our knowledge. The problem which he discusses is one of the two late additions to the physical burden placed upon telephone enterprises. It is to be hoped that the fullest opportunity will be given for engineers to study the situation as Mr. Miller has presented it, and I can see no reason why his contribution is not most worthy of being given its place in the records of the Institute.

So small a part of the power resources of the country have been developed that we must expect an enormous increase in the amount of electrical power transmission. There seems to be no reason why we may not expect the transmission of very much more power than that available in waters. The utilization of fuels must be expected to call for additional electrical transmission. With a continued growth in population we must expect more and more of the highways to be occupied by long distance transmission and telephone lines; so that even if the difficulty of which Mr. Miller writes shall become intrinsically no greater, we must expect a very great increase in the amount of disturbance requiring to be prevented.

I would wish to emphasize as strongly as possible the feature with which the paper is opened. I refer to the financial burden which has been laid on the telephone business by almost every change which has taken place in other electrical organizations. If you will recall the phases through which telephony has passed, you will see that they have been many and distinct, and that some of the most radical and costly would not have been required at the time and in the degree they were, except for the appearance of new features in electrical power generation and transmission.

I emphasize this point particularly because it seems to me that the telephone business is unique in those unfortunate experiences. I do not mean that other arts, in their earlier stages, have not made frequent and radical changes; but I have been able to think of none in which so many changes were required—or at least precipitated—by some change in another not very closely related art.

Such hope as we have had for the future has been based on a feeling that telephony is approaching a condition when it may be considered immune to outside influences. Many conservative engineers have recorded such a belief. Do you now think it has been warranted?

You will remember that the earlier telephone systems all were operated over lines of a single wire each, using the earth as a return; that most of the circuits were in open wire, and that the introduction of the single-trolley, earth-return traction systems made local telephone systems almost wholly inoperative. You will recall the open-wire, single-conductor telephone systems were supplanted by metallic circuit cable systems, with interconnection between cities through metallic circuits of open wire, carefully balanced and frequently transposed. On this basis, every large system in the United States has been rebuilt, to conform with that standard of practice.

By a mere change of method on the part of transmission line operators, a very large and successful working telephone property suddenly is made less useful. And in some other parts of the country single-phase alternating current trolley systems are interfering even with long distance lines which have been placed underground throughout their length. There is no possible doubt that a long distance telephone cable laid in a conduit system and provided with a system of loading coils represents the most costly and refined method of serving its purpose which the art has produced so far. If, then, it is no longer possible to connect two cities by means of long distance lines either in the air or in the earth, without the hazard of having the circuits disturbed by other electrical systems, one is caused to wonder what course remains to be followed.

I see that these difficulties do not appeal to you as being as desperate as I am trying to show them to be, and it occurs to me that this may be because the interests of most of you lie in other directions. Nevertheless, it is most certain that one of the things which is needed is a great deal more just such discussion as this, so that we will at least **understand** each other's problems, whether or not we may really co-operate in solving them.

RUDOLPH W. VAN NORDEN.

Having been asked in a general way to discuss the operation of telephone lines in connection with long distance transmission circuits, I will treat the subject, briefly, as a review of some of the practical difficulties experienced in operation, rather than from a purely technical point of construction or design.

When the long distance transmission of power was in its infancy, ten to twelve years ago, the operation of telephone lines in connection with the transmission systems, although easily seen to be absolutely necessary and essential, was given little consideration, it being taken as a foregone conclusion that good standard apparatus and reasonably well maintained lines would give the required service.

The difficulties of operating the telephone system were increased with the adoption of higher voltages, and it has been necessary from time to time to devise methods for overcoming unlooked-for phenomena encountered in close proximity with high tension circuits.

By no means the least of the difficulties, however, can be laid to high voltage, and these are the sort that will occur on the medium voltage lines, as well as the most modern installations. I refer to the ordinary shortcomings of the simple bridging telephone system, which are overlooked and taken as a matter of coures, unless by persons of nervous temperament, who take the privilege of expressing themselves volubly to an inanimate transmitter. These ordinary shortcomings do not interfere with the power transmitting efficiency of a system so long as they permit intelligent conversation and there are no transmission troubles to contend with at the time. It is at the critical moment of some accident or interruption, when seconds count, and the perfect working of the telephone is imperative. It is at just this time that the petty annoyances are magnified, and in all probability, the cause of trouble to the power system will be a cause of trouble or interruption to the telephone.

It is, therefore, very necessary, in designing the transmission system, not to consider the telephone as an afterthought, to be installed in any convenient manner, but as a very essential part of the system, to be designed and carried out with the same care that the other component parts have been worked out.

*Paper read before San Francisco Section, American Institute Electrical Engineers, April 18, 1908.

The greatest fault that most power companies have committed in underestimating the importance of the telephone, is, building it too cheaply. The saving of a few minutes or even seconds' time by its proper working, at a critical moment, may often save the cost of enough damage to pay for several good systems.

The use of copper or aluminum instead of iron lines, of well insulated high grade instruments, properly mounted with carefully selected bells and ringers, and fuses and cutout devices, especially designed for the service, careful placing on the pole line (if it must be on the same line), on proper insulators and arrangements so that the patrolman will have no difficulty in communication at any and all times, are all of essential importance, and should be carefully considered, as on them depends the safe and satisfactory working of the system.

Electrostatic disturbances from the transmission system are often curious and annoying, when all apparent precautions have been taken to eliminate them. The writer has found that the most satisfactory service can be given when the telephone line is transposed at equal intervals so as to make an even number between switching points on the transmission.

As great a distance as is possible, between the transmission lines and telephone lines is advisable, aside from the prevention of actual contact, to minimize the disturbance in case of grounding or breaking or otherwise unbalancing the transmission system. It is, however, often impossible in such a case to prevent a disturbance which will make intelligent conversation out of the question. As before stated, at such a time communication is indispensable, and a carefully worked-out system of procedure should be followed by operators at the stations, especially if there are several points of power supply and delivery connected with the system affected. The writer has found this to work very satisfactorily, using a set of simple rules, thoroughly understood and put in practice by an occasional drill.

Line disturbances are sometimes so severe as to destroy apparatus and endanger the lives of operators. The writer at one time had a set of telephone instruments constructed by one of the leading telephone manufacturers, to operate on a particular system. These instruments were of the highest grade, with extra powerful ringer magnetos and loud bells. The wire of the magnet coils of the bells was much more heavily insulated than in ordinary practice. The induction coils were equipped with a tertiary winding for the receiver circuit, the whole coil being heavily insulated and contained within a receptacle filled with oil. The tertiary circuit, being practically closed, rendered the coil almost inoperative, and was cut out. The instruments otherwise, while possibly more proof against burnouts, were about as effective as ordinary standard instruments.

The best protection from lightning, direct contact with a high tension circuit or from heavy electrostatic discharges, seems to consist of fine wire fuses, two to three feet long, which will blow out before serious damage can result to the instrument. These fuses have generally been home made and various modifications entailing tell-tale devices are in fairly successful operation.

The question of insulation is an important one. A leak even if of very high resistance, will cause an unbalancing which may easily put the system out of service. Thus, care must be not only practiced on the line, but within the stations, and too great care cannot be exercised in mounting the instruments, bells and fuses.

The telephone manufacturing companies have developed standard apparatus to a point of good efficiency, but the specialization for transmission work seems to have been sadly neglected. Furthermore, in the requirements necessary, they seem to be much at sea. This is particularly so with that part of the equipment which the patrolman must handle.

A study of the methods of the persons who are to use the instruments and of the manner in which they are likely to use them is of importance.

Especially thoughtless, often, is the designer or operator in his consideration of the patrolman on whom much dependence is placed. Few people, not having actually observed him, have the slightest conception of the difficulties and hardships which he has to contend with, especially in mountainous districts. The importance of his work is often only magnified to those who are in a position to criticise him if he does not perform his duties promptly and efficiently, but the effect of inefficient, unsatisfactory and dangerous telephone instruments, in the discouraging effect on the temper and frailty of human nature, is seldom given a fair hearing.

There are several methods in vogue for his communication. He may carry a portable instrument which can be bridged on the line, by climbing a pole to the line, or wires may be brought down the pole, permanently, to within reach of the ground, and to which he may connect upon standing on an insulated platform. An instrument may be located at intervals of every mile or so, ordinarily cut out from the circuit and protected within a wooden box. The first and second of these methods would probably be preferable if a satisfactory portable instrument could be had. The writer has never seen one that was not too bulky and heavy, although many of them, each guaranteed to be perfection, have been tried and used. If reasonable care could be used in transporting the instrument and in handling it, many of the portables would be satisfactory; that seems to be, however, out of the question. The instrument must be light and easily attached in a hurry; it will be alternately soaked with rain and then left in the sun, and will always have any amount of jolting. During the summer, exposed rubber parts will oftentimes become so soft and plastic as to render that part useless, and the batteries which are generally hard to get, deteriorate rapidly.

Where stations are used, even if well protected and maintained in good condition, they must be several miles apart. The patrolman is usually alone, he may find a break of some kind that he can repair, or possibly one that must be quickly attended to. The getting to a telephone station, it may be, over a difficult hill or through a storm, may occupy very valuable time, and the strength and endurance expended thereon may greatly impair his work, and unless he be a very conscientious man, may give him good cause to slight his work.

Another point which has been pretty thoroughly overlooked is the satisfactory ringing of bells. All powerhouses have more or less noise, generally a great deal. While not always disagreeable, and often easy to get accustomed to, it very effectually drowns out many other sounds, and by the fact of the operator's getting used to it, he will fail to notice other sounds which he really hears. This is true with telephone signals. If now, as is often the case, the bell, while loud enough for a quiet room, has really very little power, the chances are (unless there is a special telephone operator), that the man on duty will pay no attention to it if he hears it at all.

To remedy this trouble, the first thought is for a good strong extension bell. This may be bridged directly on the line, or it may be operated by a local battery current or other source, contact being made through an annunciator drop. Both methods are unsatisfactory. When the bell is connected directly to the line, it generally means another coil across the line at that point, which probably has already as many as it should. If, as in many cases, the line has a fairly high resistance, the bell will not respond to a feeble ring, as, for instance, when the patrolman calls in. If an annunciator is used, we have the same defect, although possibly to a lesser degree; in addition, the drop is uncertain, due to the great variation in the strength of the ringing current. Again, if the drop is used, the auxiliary bell will ring continuously without giving the attendant any knowledge of what the call may be, and generally necessitating a useless trip to the instrument. In either of these cases, a heavy electrostatic disturbance may ring the bell.

A method which the writer has used with much success consists of a simple make and break apparatus to operate an auxiliary bell. This make and break has a very light "L" shaped strip of flat copper, pivoted at its angle, one end slotted and slipped over the vibrator of the bell, the other end bent down so as to dip into a small iron cup containing mercury. A drop of oil is added so as to float and form a thin film over the mercury. The slightest movement of the ringer, even if not sufficient to make the bell sound, will cause the arm of the "L" shaped piece to dip into the mercury, vibrating with the ringer, thus alternately closing and opening a local circuit. The bell which may be as loud as desired, can be located at any convenient place, and if of low resistance, can have mounted with it in series, a 32-candlepower lamp, the whole taking current from an exciter or lighting circuit.

Devices for the safety of persons using the instruments must, of course, come in for full consideration. These are simple and easily provided for, although history of the last few years has furnished accounts of distressing and curious accidents when all apparent precaution had been maintained.

MR. G. H. BRAGG.

Mr. Chairman and Gentlemen: Nobody realizes more than the transmission man, how fine it would be to have a telephone line, which would not be affected by power lines when the power lines are in trouble; and as Mr. Van Orden states, it is usually the case that, when we need the telephone line most, it is out of order, due to the influence of the power lines.

It might be of interest to some to hear of the success we Orden states, it is usually the caste that, when we need the the power wires. For all distances up to 100 miles, we find no trouble whatever in talking when conditions on the power lines are normal. The telephone wires are usually of copper or aluminum, and are on an average of eight or ten feet from the power wires. As stated already, these are rendered useless when the power wires become grounded.

Referring to the troubles of the telephone companies caused by power wires paralleling them for any distance, I am inclined to think that a good deal of it could be eliminated if the telephone lines were kept absolutely clear of trees and grounds. I recall instances wherein the telephone company has complained that certain ones of their leads were being influenced by our power wires in spite of the fact that load conditions were in balance. We could do nothing, of course, and after a time would learn that the telephone line was O. K. again, and a little tree trimming was the remedy.

Another source of trouble on the telephone lines exists, I think, in the weakness of the insulation in certain parts of the telephone system, as for instance, the small size of insulator used on the line, and the thin insulation on the wires at the exchanges. On all of our telephone work we insulate sufficiently to take care of a 10,000-volt system, and in this fact, as much as in any other, it is my opinion that the success of our telephone systems is obtained.

Of course, the insulation used by the telephone company is quite sufficient to take care of the e. m. f. produced by their ringers and talking batteries, but is not sufficient to take care of the electro-static effect produced by high voltage power transmission lines.

MR. WYNN MEREDITH.

Some means of communication between the power house and centers of distribution is a necessary feature of all electric transmission plants. The telephone has been used exclusively on account of its simplicity. Unfortunately, its extreme sensitiveness makes its use unsatisfactory or impossible at times when it is required the most, that is, when there are difficulties on the transmission circuit. There was a time in the early days of transmission when a quiet line was considered more of an accident than the result of careful and intelligent construction. Fortunately this time has passed, as with the proper spiraling of the transmission circuits and the transpositions on the telephone lines half way between the transpositions of transmission lines and a little juggling of telephone transpositions, a satisfactory and quiet telephone line can almost always be had, but only so long as the transmission circuit itself is in first-class condition.

In spite of the best planned and carefully located transpositions, a leaky insulator or ground on the transmission circuit puts the telephone system out of commission. At such time the transmission business must be carried on by a pre-arranged sequence of operations and regulation between the power house and the sub-stations until the trouble is removed and the telephone system made operative again.

To obviate this difficulty as far as possible, I have in many cases installed telegraph instruments in conjunction with the telephones, and had the operators become experienced in the use of the key, sufficiently to transmit the necessary communications for satisfactory operation of the power line. When the telephone has become inoperative, a pre-arranged sequence of trial circuits for the telegraph instrument has never failed to result in establishing a line of communication.

The next step would appear to be the use of printing telegraph. There are several satisfactory instruments in the market, and I believe that their use will insure a more continuous and uninterrupted service than the telephone, between terminal points. The telephone will probably have to be used for line repair work and such emergency service, but there is no reason why the printing telegraph should not be used in conjunction with the telephone, and in this connection it would have an additional advantage in that all orders given and received would be printed and records of the same maintained at both ends, thus obviating any question of a misunderstanding of orders.

Not the least of the difficulties attending telephone work in connection with high potential transmission lines is the danger to the operators from accidental contacts or leakage of current to the telephones from the transmission lines. Insulated stools and platforms are undoubtedly a great help and give considerable confidence, until one finally gets a considerable chunk of high potential juice, which sets one on one's back in the middle of the floor, watching the telephone burn up and drop piecemeal to the floor in fused masses; then one begins to think that something more is required.

I have equipped many moderate potential lines with a long enclosed fuse in the telephone circuit, the instrument end being separated from a ground connection by a film cut-out. This usually saves the instrument, and also the operator, but causes no end of trouble by letting go when switching of heavy currents is done, and at other times when it should not. Furthermore, it does not seem to be quite applicable to very high potential lines. Something of a more satisfactory protective character is evidently needed.

Mr. H. W. Crozier—In the matter of getting a quiet telephone line on transmission lines, some considerable work has been done by me, and after the construction work is completed, I have found it a good plan to cut in additional transpositions wherever a branch occurs from the disturbing source.

One case will illustrate. A telephone line was built on an electric railroad line which was paralleled for three miles by a 60,000-volt, two-circuit transmission line, and a 2,000-volt line. The telephone line of copper was regularly transposed every eighth pole, and when completed, was very noisy. After satisfying myself that it was clear of grounds, additional transpositions were cut in at the poles opposite where the high tension line approached and left the telephone line, and also opposite a transformer, making three additional transpositions. The telephone line was then quiet. There was no current on the electric railway circuits at the time. It was a simple case of balancing against a known disturbing element.

I have also found that grounds on a high tension line will make a very considerable disturbance, and particularly if the system extends over any considerable country. The Blue Lakes Co. operated a considerable mining circuit at 10,000 volts, there being no grounds on the system. Telephone lines of the Sunset Co. and of the Power Co. were carried on cross-arms on the same poles. An accidental ground on one of the 10,000-volt wires made the lines exceedingly noisy and made connections to ordinary ground return lines impossible at any exchange in the vicinity. A great deal of trouble was caused to everybody till the ground was located and cleared. While this trouble was on, the telegraph company was able to handle business as usual, but the operators could not adjust their instruments so that they would vibrate with the induced current in the telegraph lines. The telegraph line did not run as close as the telephone lines, but it paralleled the high tension lines for some 35 miles, and approached as close as 12 feet in places.

In the matter of using a printing telegraph, it seems that a fine place for this would be in the interurban electric railway field. Instead of sending orders by telephone to be copied by the receiving conductor on a manifolding machine in the telephone booth, it would be an excellent plan to use a printing telegraph machine. A combination of a Blake signal and a printing telegraph should make a fine dispatching system. All the conductor would have to do upon stopping for orders would be to send his signature and get the dispatcher's "complete." This is under the assumption that the printing telegraph would print a message which it would not be necessary to repeat. The Blake signals are operated by a single wire, and are not affected to any great extent by the high tension lines, and a printing telegraph should at least be as free from interference. It would be well to try out a printing telegraph on this kind of work.

MR. G. DEAKIN.

The discussion resulting form Mr. Miller's paper of tonight has brought out a number of very good suggestions regarding the operation of private telephone lines on power circuit poles. These suggestions, however, cannot be taken as applying with anything like equal force to commercial telephone lines, particularly toll lines, as operated by telephone companies. The reason for the existence of the two classes of telephone lines are entirely different. In the first case mentioned, the telephone circuit is of secondary importance, and is useful only as long as it facilitates the operation of the power transmission system. On the other hand, the lines of a telephone company exist in order that transmission they afford may be sold to the public, and, therefore, are of first importance, and are useful only as long as they are a source of revenue.

Closely connected with the subject of induction is the question of protection, since extreme cases of induction, due generally to the complete unbalancing of the paralleling power line, often put the adjacent telephone circuit in a very dangerous condition. From this view-point private lines on power poles differ decidedly from a commercial telephone line. A private line may be operated successfully with the induced potential of both sides of the line from ground materially above 350 volts; for this reason the protective systems which can be installed with safety on one class of lines may be entirely unsuited for the other. For example: open space cut-outs with thick mica separators operating from 800 to 1,000 volts such as must often be used on private lines on power poles could not for a moment be considered as affording satisfactory protection to a commercial telephone line, on which experience has shown that air gap protectors operating at approximately 350 volts must be installed, to protect property and users from personal injury. The above statement may be modified where repeating coils are used to separate the exposed and unexposed portions of the telephone line. Such repeating coils, however, are generally impracticable on commercial toll lines, due to the loss occasioned by them and to the difficulty in ringing. This latter point will be clearly understood when it is considered that a repeating coil must be designed primarily to transmit as efficiently as possible the feeble voice currents at very high frequencies ranging from 350 to 3,000 P. P. S., and at the same time must be able to transmit the ringing current which generally has a frequency of about 20 cycles per second. Insulated platforms and the like such as used at power stations afford admirable protection to the user of the telephone line, but are obviously out of the question on commercial telephone lines. Further, an attendant at a power station realizes the danger connected with the use of a private line, and acts accordingly. The public, however, as they have good reason to, consider a telephone line harmless, and, therefore, are not particular how they handle the sub-station apparatus.

It has been suggested that insulators affording a greater degree of insulation might be of benefit to a telephone line subject to inductive disturbances. Where the weak spots in the insulation of the entire circuit under proper maintenance exist in the open wire line, better insulators would no doubt reduce the disturbance. In actual practice, however, the weak spots in commercial lines are generally found in the apparatus, insulated wire or cable connected to the open wire line; under these conditions a greater insulation of the latter would be of little or no advantage.

Mr. Miller has pointed out very clearly that the effect of induction on a properly transposed telephone circuit is noticed because of the impossibility of obtaining an absolutely uniform insulation resistance, which results in a flow of current from one side of the line to the other. Uniformity in insulation is entirely independent of the degree of insulation, and it is a factor that can be but imperfectly controlled by careful maintenance.

When considering cases of induction it is sometimes convenient to consider electro-static induction as **potential** induction, since the value of the induced potential from ground on the telephone circuit is dependent upon the potential of the disturbing circuit and is independent of the current and frequency of the latter. On the other hand, electro-magnetic induction may be considered as **current and frequency** induction, since the induced potential in this case is dependent upon the current and frequency of the disturbing circuit and not upon the potential.

From the preceding statement it follows that electro-static and electro-magnetic induction are not in phase with each other, the latter lagging behind the former as the current in the disturbing circuit lags behind the impressed potential.

Mr. Miller's paper is particularly applicable to the Pacific Coast, where the greater part of the disturbance noticed in telephone lines paralleling power lines has been found to be due to electro-static induction resulting from the high potential of the disturbing circuits. Until the advent of the single-phase railway system this electro-static induction was considered to be about the worst enemy of a quiet telephone line. This statement still holds true where the current in the disturbing circuit is not great, and it is for this reason probably that single-phase railroads on the coast have not given telephone companies more trouble than they have. In the East, however, some single-phase systems of great magnitude have been installed, and from all reports the effect on neighboring telephone and telegraph circuits, whether in open wire, aerial, or even in underground cable, to say the least is alarming.

The disturbance in the telephone circuit appears to be due almost entirely to electro-magnetic induction resulting from the powerful alternating field set up by currents of large volume flowing through the trolley and ground return circuits and to the fact that the considerable separation existing between the trolley and the ground return prevents the

inductive effect of one side of the circuit being appreciably neutralized by the opposite inductive effects of the other side of the circuit.

What is particularly disturbing to the telephone engineer is that lead-sheathed cable affords but little protection against this form of induction. At the present time the only solutions to the problem appear to be in obtaining a greater separation between the disturbing and the disturbed circuits or by inclosing the latter in a magnetic shield such as an iron pipe. Both of these remedies are extremely costly, particularly where they must be applied to existing construction.

Mr. Hunt—Gentlemen, is there any one else who can help us out?

MR. F. V. T. LEE.

In my eleven years' experience on the coast, I have heard of more telephone troubles tonight than I have ever heard before. On the other hand, I have heard the most encouraging thing tonight I have heard for a long time, and that is that the telephone companies are beginning to work out solutions of their troubles themselves, instead of simply abusing the power companies.

It is a fact, also, that we have much less trouble and fewer complaints from the telephone companies today than we had seven or eight years ago. We ourselves have improved the insulation of our own telephone lines, as well as of our power lines; but we have generally introduced the grounded neutral due to the increased voltage of our lines. Nevertheless, the telephone companies today are giving better service than they did before, and they have done it in spite of the difficulties that have been introduced in late years, showing a definite advance in the science, and I think this is one of the most promising conditions that we have before us now. Since there has been a more intelligent scientific application of the art of telephony, the troubles have materially decreased, and will continue to decrease until the present crop has entirely disappeared, when we will be ready for the new ones yet to develop.

Mr. Hunt—Gentlemen, I think we have had a very profitable evening, and before adjournment I want to thank Mr. Miller, on behalf of the branch, for starting the discussion for us in the very excellent paper he has given us. If there is nothing further, we stand adjourned.

ENGINEERING HONOR.

Dr. Schuyler Skaats Wheeler, past president of the American Institute of Electical Engineers and president of Crocker-Wheeler Company, recently (May 4) addressed the Engineering Society of Columbia University on the subject of Enigneering Honor. As an under-graduate at Columbia, in the class of '83, he, with Prof. F. B. Crocker, had addressed the same society on technical subjects.

After declaring that he felt the audience before him to be more sympathetic than any of the audiences he had addressed on engineering ethics, he alluded to the ethical codes of the various so-called learned professions. He spoke also of the code which he proposed in his Presidential Address before the American Institute of Electrical Engineers. He said that Francis Bacon had written a brief but comprehensive treatise on this subject in the preface to his "Maximums of the Law," as follows:

"I hold every man a debtor to his profession; from the which as men of course do seek to receive contenance and profit, so ought they of duty to endeavor themselves by way of amends to be a help and ornament thereunto."

Dr. Wheeler mentioned the three great duties of the engineer in the order of their importance, first the engineer's duty to his client, second to the public, and third to his engineering society. He condemned strongly the publication of false scientific and false engineering statements in the newspapers, and he declared that discoveries and inventions should be announced not in the daily papers, but through the technical societies or the technical press.

EVOLUTION OF CAST IRON PIPE.*

Continued.

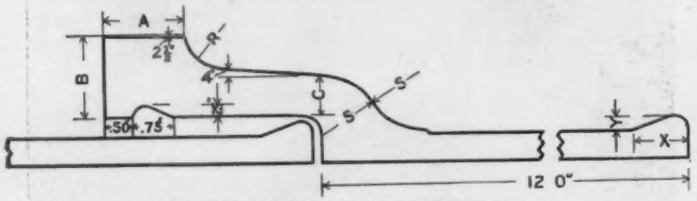
Leakage.—Excessive leakage is often wrongly charged to the bell and spigot joint. In a widely-quoted "Report on the Measurement, Consumption and Waste of Water Supplied to the Metropolitan Water District" (1904), by Dexter Brackett, Esq., Engineer of the Distribution Department, Metropolitan Water Works, Boston, the causes of waste are clearly set forth, but nowhere therein is the bell and spigot joint complained of. It is stated: "Water is wasted, either negligently or wilfully, from mains and service pipe in the public streets, or from pipe and fixtures on the premises of the water takers"; and it is pointed out that the amount of such waste from street mains and service pipe is a much larger percentage of the total consumption than is generally estimated. In this report it is further stated: "In the Metropolitan Water District there are 1,457 miles of pipe, on which there are 750,000 leaded joints, from which leakage may occur." With reference to this

A LONG EASY CURVE WITH FULL LENGTH PIPE.

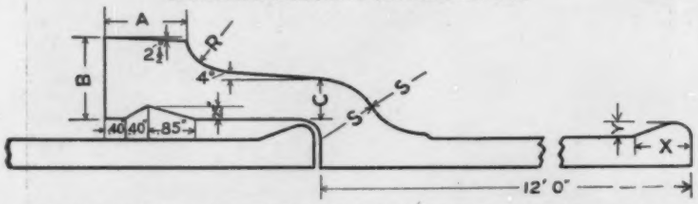
leakage, Mr. Brackett writes: "Under the heading of 'Waste from Street Mains and Services,' the report gives figures which show that there is a large underground leakage from the street mains and service pipe, as distinct from the waste and leakage on the premises of the water takers. In each example given, the street mains and service pipe are considered jointly. No mention whatever is made of the leaded joints as a source of waste. The underground leakage occurs from broken mains and services, from broken connections between mains and services; also services abandoned and left running, and from defects in the leaded joints." Defects in the leaded joints are usually due to outside influences, and otherwise, it may be repeated, are not likely, if due care is exercised in putting down the pipe. It will be noted the report does not hold the leaded joints responsible for waste, but clearly shows how excessive leakage is rather very largely due to broken mains and services which often remain long undiscovered, the water escaping into sewers, into the ground, or into some stream. As an example of this, we quote again from the report: "A very forcible illustration of this source of waste has been furnished in the town of Stoneham. During the first six months of the year 1902, about 800,000 gallons per day were

*Contributed by R. W. Martindale.

supplied to the town. As this quantity appeared larger than was needed for legitimate use, an investigation was instituted for the purpose of learning where the water was used, with the result that four leaks in the street mains were found, which gave no surface indications. After these were repaired the consumption of water fell to 330,000 gallons per day, indicating that 470,000 gallons per day had been wasting from a few unseen defective pipe." In considering this report, it should be borne in mind that many of the mains which were tested form parts of water-works systems installed many years ago, when perhaps not so much care was taken in the laying of pipe as is now generally the case, and in all these years, therefore, it is not surprising that because of settlement and inattention, broken mains and services developed and were overlooked. All of this goes to show that nowadays the problem is hardly that of the leaky joint, for this report is rather an argument for heavier and more permanent mains, carefully laid, and for that "eternal vigilance" in caring for them which will go a long way to insure minimum leakage. On the other hand, a moment's reflection will show that for permanent underground mains, if maximum efficiency and a minimum leakage are to be secured, short-length, light-weight pipe, especially those with bolted joints, are to be avoided.



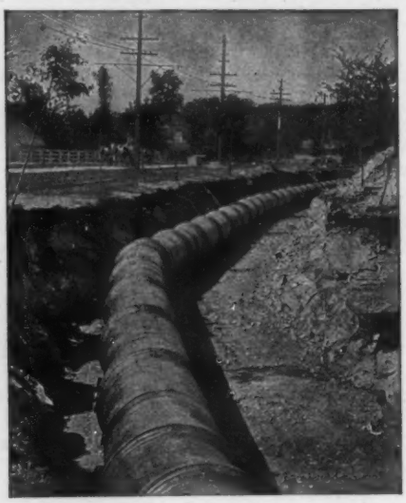
STANDARD BELL AND SPIGOT FOR GAS.



STANDARD BELL AND SPIGOT FOR GAS WITH ROUNDED GROOVE IN BELL.

Standard Cast Iron Pipe and Specials for Gas are now made under the standard specifications of the American Gas Light Association, which specifications were prepared with the assistance of some of the most practical pipe manufacturers in the United States. It should be noted that all gas pipe is also cast vertically in lengths to lay 12 feet, insuring a minimum number of joints and consequent reduction in leakage.

In the built-up sections of cities, where streets are crowded underground with other structures, and surface traffic is heavy, the tendency seems to be to increase the thickness of the metal, and to use exclusively pipe having bells calked with lead, as securing the most flexible joint. Such pipe with lead joints are also preferable where conditions of sub-soil, as in newly made ground, indicate possible subsidence. In any location, these heavier pipe with joints well calked with lead or made with cement, afford the most permanent and safe conduit, naturally costing more than lighter pipe; but when well laid under a paved street will repay such increased cost in requiring fewer disturbances of surface and consequent extra outlays for repaving. To insure good results, the lead joint must be well made; some engineers now twice calk each joint, but care should be taken to properly yarn each spigot, otherwise trouble will result. In looking for the cause of leaky lead joints in a gas main laid near one of our plants, a number of pipe were broken out of the line. On machine cutting lengthwise through the bells of joints which did **not** leak, it was found that ample yarn had been used and the lead well calked in against it. On the contrary, in cutting through several leaky joints, they were found to have been carelessly made, with the yarn put in loosely, and in some instances so little of it used it might as well have been omitted altogether. No matter whether the pipe be put down with lead or cement, the joints in the trench should be carefully made and tested, preferably before backfilling. This is perhaps more essential in gas than in water mains, and test in the open trench is now the usual practice of leading gas engineers. In gas mains, as with water, the bell and spigot joint is not the only source of leakage. Here again "eternal vigilance," in watching over the distribution mains, services and meters, aids materially to insure a minimum leakage.



CAST IRON MAIN BEFORE TEST IN OPEN TRENCH. ALSO SHOWING CURVE WITH STRAIGHT PIPE BEYOND BEND.

Gas Mains with Cement Joints.—The results obtained with cement joints have been quite remarkable, and account for the growing use of pipe so laid in residence and other sections of cities and towns where the street traffic is comparatively light, as well as in the open country. One of our friends writes that from early in the year 1899, when he began using cement, to early in the year 1905, he has made joints of the following numbers:

Miles of pipe Laid	Size	Number of Feet	Number of Leaks which developed after mains were covered, 1899 to 1905.
9 miles 5,020 feet	4 inches	52,540	4
111 miles 2,942 feet	6 inches	589,022	2
6 miles 5,213 feet	8 inches	36,893	1
4 miles 5,158 feet	12 inches	26,278	4
2 miles 5,022 feet	16 inches	15,582	8
3 miles 2,900 feet	20 inches	18,740	10
2 miles 2,693 feet	30 inches	13,253	23
142 miles 2,548 feet		752,308	or 52 leaky joints

out of approximately 80,000 joints of pipe and specials.

In the foregoing piping, all joints are of cement; no lead or expansion joints were used, and the figures seem to establish the cement joint as highly satisfactory. It will be noted,

however, that the number of leaky joints of 20 inches and 30 inches diameter is relatively greater. This is attributed to the fact that they were laid when the men who put them down had little experience in making cement joints of these larger sizes, and before they "appreciated the immense importance of maintaining a nearly constant temperature of joint and contiguous pipe, from the time the joint is made until it has had time to thoroughly set." Another engineer writes of an experience with cement joints extending over thirty-six years. The works now under his charge have about 122 miles of cast iron street mains, 3 inches to 36 inches. In this system, located in New England, no lead joints are used, all pipe and

GAS MAIN WITH LEAD JOINTS.

specials are put down with cement, and no trouble is experienced owing to expansion. While some of the mains are in paved business streets carrying comparatively heavy traffic, they are well laid in comparatively deep trenches, and a leaky joint is very rare indeed, and then nearly always due to outside influence, such as excavations for other mains or structures.

The limit of size of pipe with cement joints seems to vary with different engineers. One uses cement up to 16 inches; another, "up to 12 inches inclusive, and on larger sizes lead joints only, as a leaky joint is not so likely to prove dangerous to the men making repairs." Others, again, use cement joints up to 24 inches on comparatively long mains, while there are

30-INCH CEMENT JOINTS.

cement-joint 30-inch and 36-inch mains of shorter lengths. In the earlier development of cement joints, bells 5 inches deep on smaller sizes, and 6 or even 7 inches deep on larger sizes, have been used, but the results have not been such as to warrant the extra expense. The good results shown in table above were obtained, with slight exceptions, with pipe having bells of the standard dimensions.

Cement Joint Bells and Spigots are often made without grooves in the bell, and generally with somewhat greater joint room than for the lead joint. In making cement joints, the pipe should be supported by blocks in the usual manner, and after starting a joint, it should be completed promptly. In hot weather it is most important to keep the pipe cool and at a uniform temperature until the joint is set—about twenty-four hours. This may be done by covering the pipes with boards and hay, or with about 6 inches of earth kept constantly wet while the sun is on the pipe. During warm

A FRESHLY MADE CEMENT JOINT.

weather, as far as practicable, it is better to make the joints in the early morning, protecting them during the day, and after testing the following morning, back-fill the trench. If it is necessary to make cement joints in freezing weather, care should be taken to warm the joints and avoid exposure to a freezing temperature until set. This involves some extra trouble and expense to provide sheet iron hoods and torches, and to more thoroughly protect the pipe in the open trench. The men handling cement should wear rubber gloves, and be trained to this work. Before entering the bells, the spigot ends of the pipe should be carefully yarned with untarred jute yarn twisted into a rope of about the same diameter as the joint space, and thoroughly grouted with neat cement

CEMENT JOINTS.

mixed with water to the consistency of cream; this yarn should then be well driven against the back of the bell. The cement should be of the best quality, mixed by hand in very small quantities, in the proportion of three-fourths cement to one-fourth water by volume, and thoroughly kneaded. The cement should then be pushed into the socket with a hardwood or steel stuffing tool, then a second piece of yarn as before, twisted around the pipe and driven into the cement with calking tools, after which the joint should be faced by hand with neat cement mixed as above, finishing with a neat fillet around the end of the bell.

(To be continued.)

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EDITORIAL.

PSEUDO SCIENCE.

"A little nonsense off and on is relished by the wisest man." Among these is the technical man, who is enjoying no little amusement over the various scientific absurdities recently published in the daily press. Many of these stories are published as regularly in the Sunday supplements as are their cousins, the descendants of the original "Two Hundred and Fifty Jokes," ofttimes disguised so as to almost defy recognition, but by the searchlight of exact knowledge revealed in their pitiable weakness. Some, like the perpetual motion machines, are manifestly impossible; others, such as successful wave-motors, are practically improbable. They are all based upon the mistaken notion that it is possible to get something for nothing. The ordinary newspaper with the utmost guilelessness presents the most preposterous and extraordinary claims of alleged scientists. These claims usually transgress the simplest natural principles so palpably that even the mere amateur readily sees their defects. This is because the editors of the papers that insert these ludicrous marvels are themselves entirely ignorant of the elementary principles of science. There is no more truthful adage than that the "shoemaker should stick to his last."

A good example of this newspaper science is afforded by the description of an electric cannon invented by a "well-known English scientist," who claims that it "will impart an initial velocity of three thousand feet a second to a projectile weighing two thousand pounds, hurling it a distance of three hundred miles, at the rate of a few thousand a day. The weapon has no recoil, noise or smoke, with a life of at least a thousand times greater than the best now in use." It is hardly necessary for us to controvert these statements, other than by saying that the entire output of the California Gas & Electric Corporation, amounting to some 90,000 horsepower, would have to be available for ten minutes to furnish the necessary power to move this mass at the stated velocity.

Nearer home in the classic precincts of Berkeley, the San Francisco Call solemnly states that Professor Voyle, of "Aurum" fame, by means of a divining rod and a psychological compass which can be used only by those possessing occult powers, had mapped out a buried city of the Stone Age. This divining rod is evidently a most dangerous instrument, for it "burned the hand of a lady who attempted to divert its point away from an outward direction." It is to be feared even more than "the high-power line of transmission for electric current from the Colgate power house," which the same paper has discovered to be a menace to successful aerial navigation.

These amusing instances of charlatanism can be multiplied indefinitely and would be harmless if their effect was limited to the risibilities, but unfortunately, nefarious schemes, such as refrigerated cold motors, wireless telephony with invisible wires and compounds for burning ashes, continue to corral a certain credulous class who accept the fairy formulae of fakirs as gospel truth, and who are even so much impressed by technical jargon as to part with their hard-earned coin for these "investments" which are not even speculative.

There is yet another aspect of newspaper science which is even more pernicious, in its attacks upon our financial body. When a newspaper for various reasons is fighting some public-service corporation, any accident or delay of continuous service is avidly seized upon by the sensation monger and luridly depicted to the detriment of the corporation. These distorted reports often contain manufactured details of things which have never occurred and of conditions which never existed. The reporter even supplies deficiency of facts from the figments of his imagination. Naturally these "ink-fish" or "penny-a-liners" have our sympathy in their attempt to earn a livelihood, but we would suggest that the manager or technical superintendent would be only too glad to furnish exact facts.

THE SEMI-ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The semi-annual meeting of the American Society of Mechanical Engineers will be held in Detroit, Michigan, June 23-26. An entire session will be devoted to papers on the conveying of materials, when hoisting and conveying machinery, including belt conveyors, the use of conveying machinery in cement plants, etc., will be discussed.

Among other subjects which will be taken up by professional papers are: "Clutches," with special reference to automobile clutches, by Henry Souther; "Some Pitot Tube Studies," by Prof. W. B. Gregory, of Tulane University, New Orleans, La., and Prof. E. W. Schroder, of Cornell University; "Thermal Properties of Superheated Steam," by Prof. R. C. H. Heck, of Lehigh University; "Horsepower, Friction Losses, and Efficiencies of Gas and Oil Engines," by Prof. Lionel S. Marks, of Harvard University; "A Journal Friction Measuring Machine," by Henry Hess, of Philadelphia; "A Simple Method of Cleaning Gas Conduits," by W. D. Mount; "A Rational Method of Checking Conical Pistons for Stress," by Prof. G. H. Shepard, of Syracuse University; and "The By-Product Coke Oven," by W. H. Blauvelt.

A lecture on "Contributions of Photography to Our Knowledge of Stellar Evolution" will be delivered by Prof. John A. Brashear, of Allegheny, Pa. The usual receptions will be held and excursions will be made to manufacturing plants, the shipbuilding yards, and various points of interest in and around Detroit. Among the excursions planned is one to the University of Michigan, at Ann Arbor. The gas power section of the society will hold a session, and the Society for the Promotion of Engineering Education and the Society of Automobile Engineers will hold a meeting in Detroit at the same time. As far as possible, sessions will be arranged so that members interested in subjects treated by the other societies may attend their sessions without missing papers on related subjects read before their own society.

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces an examination on June 17-18, 1908, to secure eligible to fill two vacancies in the position of draftsman, at $4 per diem each, in the office of the surveyor-general of Nevada, at Reno; two vacancies at the same salary in the office of the surveyor-general of Montana, at Helena; and vacancies requiring similar qualifications as they may occur in the General Land Office Service.

An examination will be held on June 17, 1908, to secure eligibles to fill a vacancy in the position of electrician-elevator conductor, $900 per annum, in the Custodian Service at Tampa, Fla., and vacancies requiring similar qualifications as they may occur in the Custodian Service in that city. The examination will consist of letter-writing; practical questions relating to electric wiring, lighting, etc., and experience, both as electrician and as elevator conductor.

"Wrinkles" in connection with the illumination of residence and small stores wa sthe subject of the regular meeting of the Chicago Section of Illuminating Engineering Society, held May 14. Many practical suggestions were brought out, which benefited those present.

PERSONAL.

V. R. Lansingh of the Holophane Company, passed through San Francisco this week on his way East.

R. E. Johnson and W. A. Cooper, civil engineers, have moved from 1370 Franklin Street, Oakland, to Rooms 1036-1037, Mills Building, San Francisco.

O. Weimer, electrical engineer, Wagner Mfg. Co., of St. Louis, Mo., has been visiting San Francisco during the past week. He will continue his trip East by way of Seattle.

D. W. Pontius, of Riverside, Cal., on May 1 became traffic manager of the Los Angeles-Pacific Railway, vice F. A. Short, who has been assigned to other duties.

J. J. Mullen representing the Moloney Electric Co. of St. Louis, Mo., manufacturers of high grade transformers, has left San Francisco on his way North after making arrangements for a local agency.

Herbert C. Petty has been elected a director of the Crocker-Wheeler Company. Mr. Petty accepted a position in the sales division of the company January, 1903, and has advanced rapidly to the position of contract manager.

TRADE CATALOGUES.

The Sprague Electric Co., 527 West 34th St., New York City, send an illustrated folder displaying the Sprague line of Stamped Steel Boxes.

H. W. Johns-Manville Co., 100 William St., New York City, send two interesting booklets, one showing the advantages of Keystone Hair Insulator for weatherproofing and sound deadening, and the other describing the Success Fire Extinguisher.

Bulletin No. 1106 from Fort Wayne Electric Works, of Fort Wayne, Indiana, illustrates and describes Direct Current Switchboard Panels for Small Plants. Instruction Book No. 3032 is a valuable manual on the installation and operation of Fort Wayne Series A. C. Arc System. Fort Wayne Fan Motors are graphically portrayed in Booklet 4507. No. 4064 presents a valuable Meter Reading Book, giving permanent record for every Central Station. These Bulletins will be sent upon application.

REMOVAL NOTICE.

The Wagner Electric Mfg. Co. has moved its offices from Oakland to Rooms 312-314 Balboa Bldg., Market and Second Sts., San Francisco.

The Tracy Engineering Company, contractors for high-economy steam power plants, have moved from 1647 Page Street to 461 Market Street, San Francisco.

The New York office of the Fort Wayne Electric Works, formerly at 40 New Street, has been moved to the fifteenth floor of the Cortlandt Building, 30 Church Street.

TRADE NOTICE.

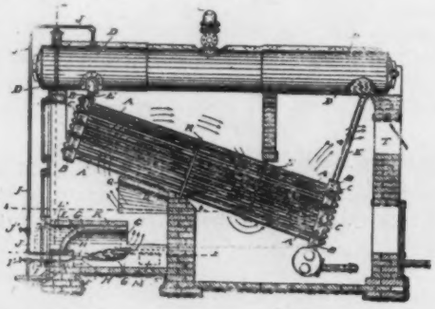
The "Street Railway Journal" and the "Electric Railway Review" have been consolidated and, commencing with the issue of June 6, 1908, will be published weekly as the "Electric Railway Journal" by the McGraw Publishing Company, of New York City.

Surplus heat from electric generators at the Trollhättan, Sweden, power station is used to warm other parts of the building. Each generator is furnished with a fan that draws cold air from the outside and drives it through the generator to the places requiring artificial heat. This power plant develops 10,000 horsepower.

PATENTS

BURNING OIL FOR GENERATING HEAT. 887,409. Thomas C. Mason, Los Angeles, Cal., assignor, by direct and mesne assignments, to Mason Smokeless Combustion Company.

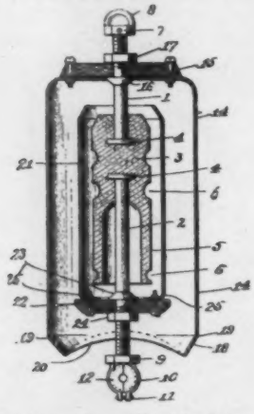
The apparatus for burning oil for generating heat, consisting of a combustion chamber, an arch therein, an externally fired steam boiler, a burner whereinto oil and steam are led in regulated quantity, situated within and near the inner end of combustion chamber, flues one at each side of the appar-



atus, openings for admitting air into flues, doors on said openings for regulating the quantity of air admitted, an arch above the arch of the combustion chamber, inclosing spaces forming parts of the flues, these flues leading into a transverse flue, and a discharge flue, from which the heated air is discharged both beneath and above the burner, an upwardly inclined arch at the rear part of the apparatus and at a higher level than the combustion chamber, for directing the heat and products of combustion up among the upper ends of the inclined tubes of the externally fired steam boiler.

ELECTRIC INSULATOR. 887,336. Herman Mieth, Vallejo, Cal.

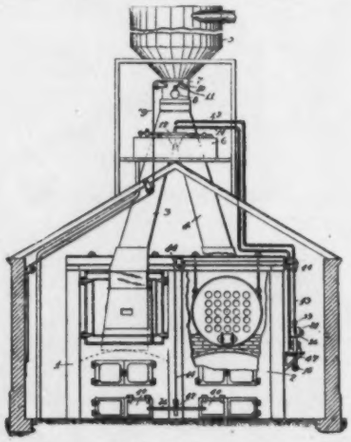
In an insulator, upper and lower holding rods having flanges at their inner ends and shoulders on the outer ends, insulation interposed and surrounding the flanged inner ends of rods to connect the same, an insulating petticoat on insulation extending over the lower holding rod, a disk of insulating material clamped against the shoulder on the outer end of the



upper holding rod, a main cylindrical casing having an inwardly flared lower edge secured to disk surrounding rods and the interposed insulation, a second disk of insulating material clamped against the shoulder on the outer end of the lower holding rod, and an auxiliary cylindrical casing having an inwardly flared upper edge secured on second disk extending upwardly into main casing over rods and the interposed insulation.

REGULATOR FOR BOILER-FEEDERS. 887,086. George W. Gardner, San Francisco, Cal.

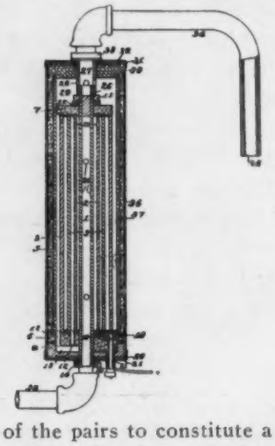
In a regulator for boiler feeders, a charge chamber, water



controlled means for emptying the same, a damper for the furnace, and means for simultaneously controlling means and the damper by the steam pressure.

ELECTRIC WATER-HEATER. 887,331. Oscar Johnson, Seattle, Wash.

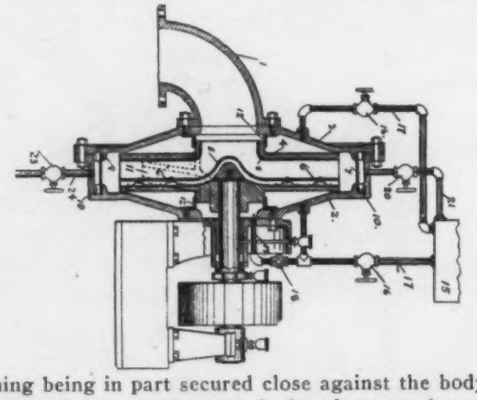
An electrical liquid heater having a series of nested tubes grouped in pairs, means connecting the annular spaces be-



tween the tubes of the pairs to constitute a liquid conducting passage, and means for forming opposite electrical connections with the respective tubes of the pairs.

CONSTRUCTION OF CENTRIFUGAL PUMPS. 887,658. Ferdinand W. Krogh, San Francisco, Cal.

In a centrifugal pump, the combination of an impeller having radiating water passages, a lining for the passages,



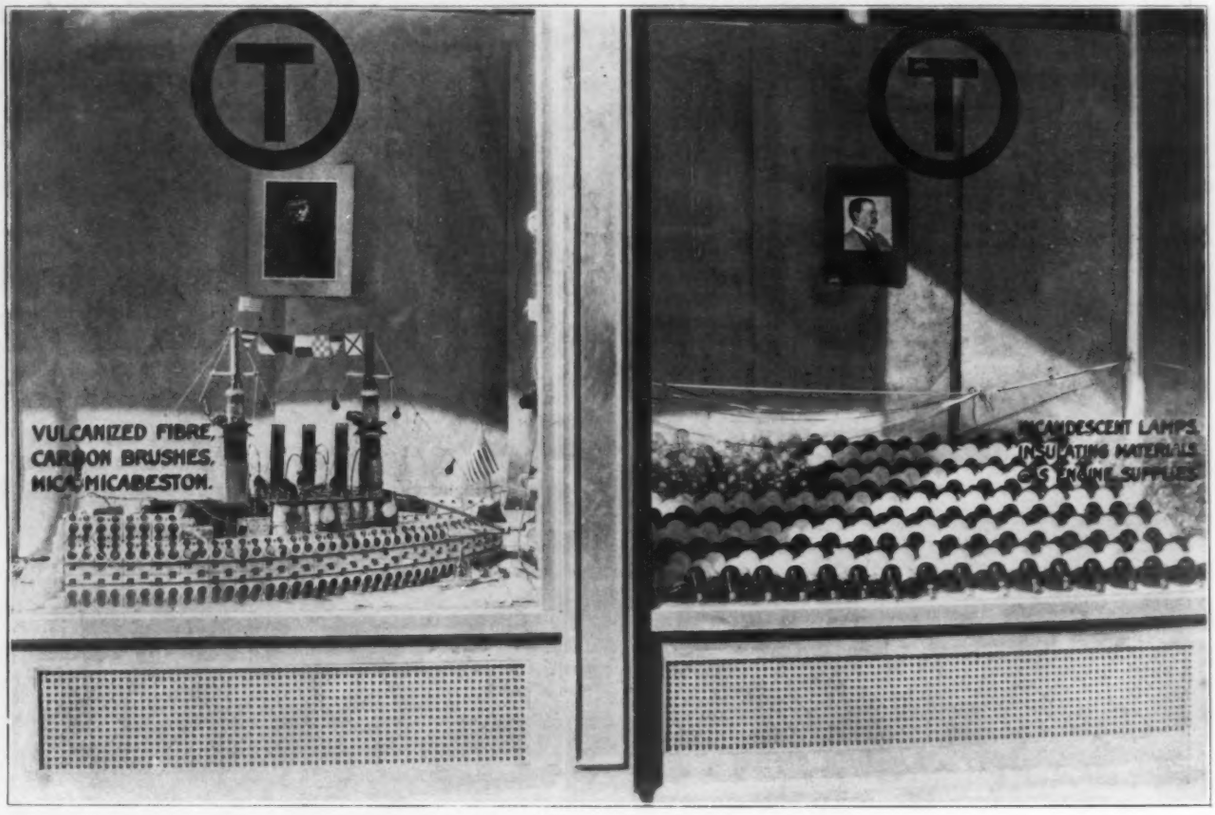
the lining being in part secured close against the body of the impeller and in part separated therefrom, and cushioning springs interposed between the frame of the impeller and the parts of the lining that are set away therefrom.

INDUSTRIAL

AN APPROVED ELECTRIC BATTLESHIP.

During the visit of the Atlantic fleet to San Francisco, the Electric Railway & Manufacturers' Supply Co., 84-86 Second Street, San Francisco, prepared a most attractive window display, as is shown in the accompanying photograph.

In one window was a miniature battleship consisting entirely of small electrical apparatus; in the other window was an American flag built up of colored incandescent lamps; these were surmounted by flags and ribbons fluttering in the breeze from electric fans. The battleship was particularly worthy of note, as it was constructed of so many varied kinds of apparatus, and was the result of great ingenuity and patience on the part of the boys in the store. To them we are indebted for the following details:



AN APPROVED ELECTRICAL BATTLESHIP AND FLAG.

The hull consisted of 44 Trumbull No. 2199 plug cut-outs, 8 Trumbull No. 2965 plug cut-outs, 8 Trumbull single-pole N. C. fuse blocks No. 25,693, 12 No. 5½ porcelain knobs.

The deck consisted of 124 carbon brushes.

Each of the two masts was built up of 1 quart can Electro Black, 1 roll Kachouc tape, 1 1-lb. can Highland Paste, 1 1-lb. spool annunciator wire, 1 trolley wheel, 1 1-lb. can fuse wire, 1 No. 9185 keyless receptacle, 1 ¼-in.x1-in.x8-in. carbon brush, 1 stick Highland soldering paste.

The three smoke-stacks consisted of 3 miners' E. R. flash-lights.

The bridge consisted of 4 feet annunciator wire, 26 binding posts.

The upper deck was made up of one piece 3 16-in. red fibre 10x16 inches, and 40 cans, 1-lb. each, Chicago fuse wire.

The four life-boats were Clayton & Lambert drip cups, suspended by eight pieces of No. 14 rubber-covered wire.

Four Ericsson hand micro-mouthpieces were used as ventilators.

A 14-volt 1-candlepower lamp inside a No. 9386 socket shell was used in each of the two searchlights.

The fighting tops consisted each of 1 trolley wheel with 2 30-ampere National code fuses for rapid-firing guns.

The bridging was done with 12 feet of No. 18 lamp cord Two pieces of wire solder were used as anchors.

The large guns, as well as those on the side and rear, consisted of flash-lights. The lower guns were made from tubes of soldering paste.

One E. R. battery ammeter mounted on a No. 50,748 receptacle shell, covered with a telephone mouthpiece, served as a compass.

The lighting was done with eight 14-volt, 1-candlepower lamps, arranged in series.

The tender on one side was made of a Thermo sleeve iron, watch-case buzzer, No. 50,746 receptacle shell, 1 midget fuse, 1 14-volt 1-candlepower lamp.

The outrigger consisted of 1 fibre rod, ⅜-in.x30-in.

The ladder, made from No. 18 magnet wire, completed the equipment, making a total of 476 separate pieces.

HUNT, MIRK & CO., INC., ENGINEERS.

The accompanying cut shows the new offices of Hunt, Mirk & Co., Inc., Engineers, at 141 Second Street, where they are now permanently located.

In a recent interview with these engineers, they report that all indications point toward a general revival of business in their field of work. Negotiations for power-plant work that were under consideration last fall, and held up on account of financial disturbances, are again active, and as the money market improves, many of these new enterprises will result in orders.

This company reports the following recent sales and power-plant work under construction:

NEW OFFICES OF HUNT, MIRK & CO., INC., ENGINEERS.

For the San Diego Electric Railway Company, they are just finishing an addition to their electric generating station, consisting of two 500-kilowatt alternating-current Westinghouse-Parsons turbo-generator units, with Worthington surface condensers, boilers, and auxiliaries.

In the city of Alameda plant, a 650 K. V. A. alternating-current Westinghouse-Parsons turbo-generator unit, with Worthington condenser and auxiliaries, has just been put into commercial operation.

For Claus Spreckels, this company is now erecting a new steam turbine power plant, which includes two 650 K. V. A. alternating-current Westinghouse-Parsons steam turbines and generators, Worthington condensers, cooling tower, Stirling boilers, two 150-kilowatt motor-generator sets, engine and motor-driven exciter sets, switchboard, etc.

The Consumer's Light & Power Company have just closed a contract with this company for a complete plant to be located in the Whitney Building on Geary Street. The plant will consist of three 300-kilowatt generators direct connected to American-Ball angle compound engines, one 125-kilowatt generator direct connected to an American-Ball duplex compound engine, together with water-tube boilers and auxiliary apparatus necessary for a complete station. The Consumer's Light & Power Company will also go quite extensively into the district steam heating business, which is a new departure in San Francisco.

For the Panhandle Lumber Company, Ltd., of Spokane, Wash., contract is about completed for installing two 650 K. V. A. alternating-current turbo-generator units with condensers and auxiliaries, at Spirit Lake, Idaho.

A 6,000-kilowatt double-flow alternating-current Westinghouse-Parsons turbo-generator unit sold to the City Electric Company, to be installed in their North Beach plant, is now being put on its foundations, and is a repeat order. The City Electric Company is now operating two 2,500-kilowatt Westinghouse turbos erected on a previous order.

For the Grays Harbor Railway & Light Company, Aberdeen, Wash., a 1,000-kilowatt Westinghouse turbo-generator has just been put into commercial service.

For the Southern Pacific Company's new electric generating station at Fruitvale, Cal., this company has secured the order for two 5,000-kilowatt Westinghouse-Parsons turbo-generators and two 12,000-square-foot Worthington surface condensers and auxiliary apparatus.

Hunt, Mirk & Co., Inc., are the Pacific Coast representatives of the Westinghouse Machine Company, of East Pittsburg, Pa., for their entire production, and are the pioneers in the introduction of the Westinghouse-Parsons steam turbine throughout the coast States. They state that while the Westinghouse-Parsons steam turbine has been in successful

commercial service throughout the East for the past twelve years, it is only three years ago that the first one was put into operation on the Pacific Coast, and, whereas the competition with the reciprocating engine was very keen at that time, purchasers of steam prime movers at the present date, in sizes as large as 300 kilowatts, almost without exception are considering the steam turbine to the exclusion of the reciprocating engine. Over 750,000-kilowatt rated capacity of Westinghouse-Parsons turbo-generator units are now in operation or on order.

The following data concerning Westinghouse-Parsons steam turbines on the Pacific Coast will be of interest:

Westinghouse Turbines in Operation on the Pacific Coast.

	Kilowatt Rated	Aggregate Rated B.H.P.
The Edison Electric Co., Los Angeles, Cal.	7,500	11,250
Luna Park Amusement Co., Seattle, Wash.	300	450
Merchants' Mutual Light & Power Co., Santa Barbara, Cal.	300	450
Claus Spreckels, San Francisco	650	975
Claus Spreckels, San Francisco	650	975
City of Alameda, California	650	975
Panhandle Lumber Co., Spokane, Wash.	650	975
Panhandle Lumber Co., Spokane, Wash.	650	975
On Order and Being Erected.		
*City Electric Co., San Francisco, Cal.	6,000	9,000
Southern Pacific Co., Fruitvale, Cal.	5,000	7,500
Southern Pacific Co., Fruitvale, Cal.	5,000	7,500
Totals	46,200	69,300

*Repeat order.

A Magnet that Attracts Business

To sell, you should first attract buyers, just as a magnet attracts iron filings. There are many ways of attracting people, but experience has shown that good advertising brings more customers in less time than any other method. It extends the seller's field far beyond the limits of individual personality. It attracts the attention of everyone at once, thereby holding old customers and inducing new ones to buy.

An electro-magnet is an iron core around which an electric current circulates through a coil of wire. The stronger the current and the more turns of the wire, the greater its pulling power. And, so, the stronger the truthful statement and the more it is seen, the more business it gets.

The advertisement that sells, tells facts so that he who reads will want to buy. To be read, it must be good copy, well set, and put where possible buyers see it. For even the most powerful magnet has no influence upon a rubber door-mat, nor will an advertisement of a refrigerating plant interest an Esquimau.

A magnet brushed through the sands of the sea, will not pick up as much as it would if run through a keg of nails. An advertisement given general circulation will undoubtedly attract buyers, but its action will be intensified if it goes among THOSE WHO WANT WHAT YOU SELL and who have the money to pay for it.

An electro-magnet is no more dead when deprived of current than is a business when not advertised. When the current stops, the magnet lets go. When advertising stops business drops off. It will be diverted into the magnetic field of another who advertises continuously.

Los Angeles Pacific Co., Los Angeles, Cal.	2,750	4,125
San Diego Electric Railway Co., San Diego, Cal.	1,000	1,500
Mt. Whitney Power Co., Visalia, Cal.	1,000	1,500
North Shore Railroad Co., Alto, Cal.	1,000	1,500
Everett Light & Railway Co., Everett, Wash.	750	1,125
*California Powder Works, Pinole, Cal.	650	975
*San Diego Electric Railway Co., San Diego., Cal.	500	750
*San Diego Electric Railway Co., San Diego, Cal.	500	750
North Mountain Power Co., Eureka, Cal.	500	750
Lewiston Water & Power Co., Lewiston, Wash.	400	600
Grays Harbor Railway & Light Co., Aberdeen, Wash.	400	600
California Powder Works, Pinole, Cal.	400	600
Los Angeles Gas & Electric Co., Los Angeles, Cal.	3,000	4,500
City Electric Co., San Francisco, Cal.	2,500	3,750
City Electric Co., San Francisco, Cal.	2,500	3,750
*Grays Harbor Electric Co., Aberdeen, Wash.	1,000	1,500

LAST YEAR'S TURBINE BUSINESS.

Retrospective of the development during the past year of the steam turbine, the accompanying figures reported by the Westinghouse Machine Company are interesting as tending to controvert the general impression that the turbine business suffered heavily during the year. Although one month's business in 1906 still holds the record at 62,100 kilowatts, the year 1907 was marked by an average demand quite as large. As late as July, orders for 34,750 kilowatts were taken during that month, as compared with 25,750 for July, 1906, which is a particularly gratifying showing. For the first nine months of each year the demand for turbines was as follows: 1907, 158,550 kilowatts, and for 1906, 152,400 kilowatts. Or, taking the middle six months of the year, from April to September inclusive, thus excluding the usual midwinter activity, as well as the late depression, the average per month is as follows: 1907, 15,833 kilowatts; 1906, 14,365 kilowatts. Thus, it is apparent that up to the period immediately preceding the depression of October the demand for turbine equipment shows a steady increase. It is interesting to note in this connection, the ultimate results of commercial activity of the past few years. Had the business of the company kept on increasing at the same rate as prevailed during 1904 and 1906, the year 1910 would have been marked by an annual output of 1,912,000 kilowatts, or the rate of 160,000 kilowatts per month.

NEWS NOTES

WATERWORKS.

Roy, N. M.—The Roy Waterworks Company has entered into a deep well contract to supply the town with water. A drilling outfit was placed on the townsite last week.

Santa Barbara.—The Board of Supervisors has passed Ordinance 325, granting the Montecito Improvement Company a franchise for a pipe line upon certain roads and highways of Santa Barbara County.

Salt Lake City.—A contract has been let for a waterworks system for the town of Florence. The contract was let to Captain A. O. Girard and Salt Lake associates, by George A. Lane and Z. Bryan, owners of the townsite.

Fort Baynard, N. M.—The Government has purchased over 25,000 acres here with the purpose of adding to Baynard territory and that the fort might be able to install a gravity water system, the total cost of which Mr. Conlan, the post architect, estimates at $100,000, including the $22,000 for the 3,000-gallon tank now under erection, a water main of over five and one-half miles and the reservoirs at springs from which the water is to be taken.

San Francisco.—An agreement as to the principal features of the water-rate ordinance was reached at a meeting at which were present the members of the special water committee, the members of the public utilities committee, the chairman of the hospital and health committee, and the chairman of the finance committee. It was agreed that the special committee should report to the board that the ordinance of 1902, under which the Spring Valley Water Company is now collecting, be re-enacted, with the change that the hydrant rate be $2.50 a month. At the present time the city is paying $1 a month for about 4,000 hydrants. Allowing for new hydrants to be installed, the budget will provide $125,000 for hydrants, $20,000 for water supplied to school buildings, $6,000 for street sprinkling, $15,000 for municipal building, and an equal amount for parks, making in all a total of $181,000.

OIL.

Los Angeles.—Fire destroyed the power plant of the Harris Oil Company, with a loss of $1,500, recently.

Coalinga.—The Associated Oil Company is having a shipping tank built to hold 37,500 barrels, on Section 8-21-15, upon an elevation allowing the oil to gravitate to its loading track on the same section. The Bunting Iron Works are the builders.

Riverside.—The Standard Oil Company, which recently lost its warehouses in this city by fire, will rebuild in the old location, Pachappa Avenue and East Fifth Street. The company will erect a brick warehouse with a galvanized-iron pump house.

Los Angeles.—It is reported that English capitalists have acquired holdings in the Pittsburg-Salt Lake Oil Company, owned principally in Salt Lake City. New capital will be used in fully equipping the rubber and asphalt departments of the company, which has offices here.

San Luis Obispo.—Lyman Stewart, president of the Union Oil Company, confirms the report that the Standard Oil Company has contracted with the Union for the purchase of 200,000 barrels of Santa Maria oil at $1 per barrel. The contract calls for delivery within two years.

ILLUMINATION.

Sawtelle.—Subscriptions for a gas plant project are being sought by members of the Sawtelle Commercial Club to supply gas to the town and vicinity.

Orange.—At the last meeting of the City Council the petition for the submitting of a proposition to vote $40,000 bonds for establishing a municipal gas plant was denied.

Santa Monica.—The City Council has passed a resolution of intention for the installation of 22 ornamental cluster lights on the 30-foot cement walk extending from Pier to Hollister Avenue.

Pasadena.—Seven bids were opened by the City Council for supplying transformers and other electrical supplies for the municipal lighting plant. The bidders were: B. F. Kierulff, Jr. & Co., Maloney Electrical Company, Westinghouse Electrical & Manufacturing Company, Enterprise Electrical, General Electric Company, and the Wagner Electrical Manufacturing Company.

Reno.—While boring for water on the island ranch owned by State Senator Douglass, in Churchill County, laborers encountered a strong flow of natural gas. The find has created considerable excitement in the section, which is close to Fallon. The flow is strong and steady. The gas was lighted soon after it was discovered and burned several hours, or until it was extinguished by the laborers, who hurried to Fallon to report their find. Arrangements are under way to pipe the gas to Fallon and surrounding mining camps. It is believed that the gas overlies an oil strata.

INCORPORATIONS.

Los Angeles.—The Walker-Heck Oil Company has been incorporated with a capital stock of $150,000 by Hattie Malloy, K. H. Kennedy, G. W., Margaret S. and Ethel G. Walker.

Ontario.—The Independent Home Telephone Company has been incorporated by J. A. Fletcher, R. P. Cardew, L. R. Kennedy, J. N. Hartley, and R. Duncan. The capital stock of the company is $200,000.

Los Angeles.—Articles of incorporation have been filed with the County Clerk for the Imperial Water Company. Its purpose is to acquire, by purchase or otherwise, water for use on the lands in its district.

Los Angeles.—Articles of incorporation have been filed by the Iowa Land & Water Company, with a capital stock of $250,000. The directors are John Metcalf, M. J. Nolan, W. A. Gage, C. H. Kegley, and Jos. Harker.

TRANSMISSION.

Placerville.—T. C. Purcell has filed a notice of location of 2,000 inches of water in the Cosumnes River, to be diverted on the north bank of the river for power and other purposes.

Sacramento.—The Board of Supervisors opened a bid for the franchise asked for by the Great Western Power Company to erect towers, poles, and monuments and stretch wires and cables for transmission of electric energy through the county roads and highways for 50 years. The only bid that was made was that of the Great Western Power Company, for $100, which was accepted.

FINANCIAL.

Porterville.—An ordinance was passed by the Trustees at their last meeting ordering the sale of the bonds for the waterworks.

Alturas, Cal.—The Alturas Electric Light & Power Company will hold a meeting of the stockholders on June 22d to consider increasing the capital stock.

Santa Cruz.—The City Council took preliminary steps on May 21 for bonding the city for $100,000 for the expansion of the electric light system and water supply and for other purposes.

Yuba City.—At the last meeting of the Town Trustees it was decided to employ an engineer to prepare plans and estimates for a water system, for which bonds will be voted when its cost is estimated.

San Francisco.—The bond election in San Francisco showed an overwhelming majority in favor of all six propositions, the vote being about 21,000 for to 1,600 against. The amount of $5,200,000 was voted for an auxiliary water system.

Los Angeles.—A resolution has been passed authorizing the sale of $340,000 waterworks bonds, which are a part of the issue of $23,000,000 bonds authorized at a special election held June 12, 1907. The bonds will be issued in denomination of $200 each.

San Francisco.—Schedules of the liabilities and assets of the Porter-Gribble Electric Company have been filed in the United States District Court, the debts of the company amounting to $12,360.41, with $3,315 assets. Steps to have the company adjudged bankrupt were taken several weeks ago by the creditors.

Oakland.—All the property of the San Francisco, Oakland and San Jose Consolidated Railway, known as the Key Route, has been deeded in trust to the Union Trust Company of San Francisco to secure a bond issue of $3,000,000 recently authorized by the directors. The list of property includes the right of way, rolling stock, shop equipment, and ferry boats owned by the railway.

Los Angeles.—It has been announced that the American Petroleum Company, of this city, has acquired 1,200 acres of oil land in the heart of the Coalinga district in Fresno County. The bond issue of $2,000,000 just voted by the company for this purpose includes an appropriation for development. Among the sellers are the Pleasant Valley Farming Company, the Ajax Oil Company, H. H. Welsh, and Thomas A. O'Donnell.

Los Angeles.—Action was taken on May 21 by the directorate of the Union Oil Company at the monthly meeting at Oleum, whereby the capitalization of $10,000,000 was increased to $50,000,000. A new company was formed to include all the subsidiaries. Last year's earnings of the company were over $2,000,000, and it was thought that the capitalization was too limited to permit of the expansion under contemplation.

Berkeley.—The report of the Berkeley Electric Lighting Company for the half year ending with the month of March was filed with the town clerk last week, and the 3 per cent of the gross receipts of the company which, according to the contract made at the time of granting the franchise, is due the town, was turned over to the treasurer. The amount received was $3,778.35. This amount is practically the same as the regular semi-annual amount turned into the town treasury upon the completion of the report of the company. It represents a total gross receipt by the company of $125,945 for the six months ending last March.

San Francisco.—President Patrick Calhoun's statements of the earnings of the United Railroads Company for the first three months of this year show gross receipts of $1,522,716, as compared with $1,606,022 for the corresponding period of 1907. Estimated figures of the company's receipts for April and the first half of May indicate that the company will probably by the end of June overcome this decrease and run ahead of those of the first half of last year. The receipts for the first eleven days of the month were the largest in the history of the company. In 1905 the company's receipts reached high-water mark with $7,066,892. In 1906 they amounted to $5,955,786, and last year to $4,745,116. In March of this year the earnings were $537,700, the first month they exceeded the half-million mark since the beginning of the strike in May, 1907.

TRANSPORTATION.

Tropico.—Much interest is being shown in the proposed electric line which will soon connect Tropico and Burbank. A bonus of $30,000 is asked for a free right of way.

Santa Ana.—It is reported that the Southern Pacific Company will electricize its track between this place and Newport Beach within 90 days, and that this company and the Pacific Electric will build a union depot at Newport.

Oakland.—A petition has been presented to the Supervisors of Alameda County by Joseph Naphtaly asking for a franchise for the construction and operation of an electric railway to connect Alameda and Contra Costa Counties by means of the inter-county tunnel through the Berkeley hills. The Supervisors received the petition, but deferred action until next week, when a special meeting will be held to consider the matter.

Berkeley.—The Oakland Traction Company has begun the work of laying rails along Dana Street north from Bancroft Way to Alliston Way, preparatory to relieving the street-car congestion on Shattuck Avenue by a loop line over Dana, Alliston Way, Oxford and University Avenues. When this loop is completed, the Telegraph Avenue cars will make a continuous trip from Oakland and back without turning the trolley. Northbound cars will run over the new loop, and returning will follow the present route over Bancroft Way from Shattuck to Telegraph.

San Francisco.—The United Railroads has formally adopted the new system of numbering the various street-car lines, which has been under consideration by the officials for some weeks. The system will be inaugurated in compliance with an ordinance passed by the Board of Supervisors requiring the company to place a distinguishing number on each car line where it can be readily seen by the public. While this system has never been used in the United States, it has been used successfully in many cities of Europe, notably in Berlin. Every line which operates on tracks with other lines has been given a number, and each car will have the number displayed in the front and rear in a box that will be illuminated at night. No confusion can result from the system, as the car lines will also have their old names, but it is expected that the numbers will in time replace the street names. The following is the schedule of the numbers as adopted: No. 1, Sutter Street; No. 2, Sutter and Sacramento; 3, Sutter and Jackson; 4, Turk and Eddy; 5, McAllister; 6, Masonic Avenue; 7, Haight; 8, Market; 9, Valencia; 10, Guerrero; 11, Mission and Twenty-fourth; 12, Ingleside; 14, Cemeteries; 15, Third and Kearny; 16, Kentucky; 17, Ninth and Polk; 18, Mission and Polk; 19, Bryant and Polk; 20, Ellis and Ocean; 21, Hayes and Ellis; and 22, Fillmore. There will be no No. 13. The number was avoided by the company, especially as that dreaded number would have fallen in its place in the schedule to the cemeteries line.

Classified List of Advertisers

Alternators
General Electric Co.
Standard Electrical Works.
Western Electric Co.

Aluminum Electrical Conductors
Pierson, Roeding & Co.

Annunciators
Electric Appliance Co.
Partrick, Carter & Wilkins Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Asbestos Products
Johns-Manville Co., H. W.

Bases and Fittings
Chase-Shawmut Co.

Batteries, Primary
Standard Electrical Works
Western Electric Co.

Batteries, Storage
Electric Storage Battery Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Boilers
Keystone Boiler Works
Moore, C. C. & Co., Inc.
Robb-Mumford Boiler Co.
Standard Electrical Works
Tracy Engineering Co.

Boiler Compounds
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Buffers
General Electric Co.
Northern Electrical Mfg. Co.

Building Material
Bonestell, Richardson & Co.
Johns-Manville Co., H. W.
Paraffine Paint Co.

Cable Connections
Dossert & Co.

Carbons
Reisinger, Hugo

Cable Clips and Hangers
Chase-Shawmut Co.

Circuit Breakers
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Standard Electrical Works.
Sterling Electric Co.

Condensers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.

Conduits
American Circular Loom Co.
Electric Appliance Co.
National Conduit & Cable Co.
Pierson, Roeding & Co.
Standard Electrical Works.
Sterling Electric Co.

Conduit and Moulding Hangers.
Chase-Shawmut Co.

Conduit Fixtures
Bossert Electrical Con. Co.
Electric Appliance Co.
Standard Electrical Works.
Sterling Electric Co.

Cooling Towers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.

Cross Arms
Electric Appliance Co.
Sterling Electric Co.

Dynamos and Motors
Brooks-Follis Elec. Corp.
Crocker-Wheeler Co.
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Northern Elec. Mfg. Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Elevators
Van Emon Elevator Co.

Electric Grinders
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works.
Western Electric Co.

Electric Heating Devices
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Standard Electrical Works.
Vulcan Electric Heating Co.

Electrical Instruments
Cutter Co., The
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Johns-Manville Co., H. W.
B. F. Kieruliff, Jr. & Co.
Sterling Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Electrical Machinery
Crocker-Wheeler Co.
Electric Appliance Co.
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.

Electric Polishers
Northern Electric Mfg. Co.

Electric Railway Appliances
Pierson, Roeding & Co.
General Electric Co.
B. F. Kieruliff, Jr. & Co.
Johns-Manville Co., H. W.

Electrical Supplies
Brooks-Follis Elec. Corp.
Chase-Shawmut Co.
Electric Appliance Co.
General Electric Co.
Northern Electrical Mfg. Co
Standard Electrical Works
Johns-Manville Co., H. W.
Sterling Electric Co.
Westinghouse Elec. & Mfg. Co.
Western Electric Co.

Electric Ventilating Fans
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Engines, Boilers, Heaters, etc.
Moore, Chas. C. Co., Inc.

Engineers, Chemical
Moore & Co., Chas. C., Inc.
Smith, Emery & Co.
Standard Electrical Works
Tracy Engineering Co.
Westinghouse Machine Co.

Engines, Gas and Gasoline
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co.

Engineers and Contractors
Brooks-Follis Elec. Corp.
Cory, C. L.
Copeland, Clem A.
Goeriz & Co. O. C.
General Electric Co.
Jackson, D. C. & W. B.
Moore, C. C. & Co., Inc.
Smith, Emery & Co.
Standard Electrical Works
Sterling Electric Co.
Thaxter, H. C.
Tracy Engineering Co.
Van Norden, Rudolph W.
Western Electric Co.
Westinghouse Elec. & Mfg Co.

Feed Water Heaters and Purifiers
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.
C. H. Wheeler Mfg. Co.

Fire Proofing
Johns-Manville Co., H. W.

Fuses and Fuse Devices
Chase-Shawmut Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Standard Electrical Works.

Ground Connection Clamps
Chase-Shawmut Co.

House Goods
Electric Appliance Co.
Partrick, Carter & Wilkins Co.
Standard Electrical Works.

Hydraulic Machinery
Goeriz & Co., O. C.
Moore, Chas. C. Co., Inc.
Pelton Water Wheel Co.
Standard Electrical Works.
Tracy Engineering Co.

Injectors
Vulcan Iron Works

Insulators and Insulating Material
Bossert Elec. Cons. Co.
Brooks-Follis Electric Co.
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Johns-Manville Co., H. W.
Okonite Co., Ltd.
Pierson, Roeding & Co.
Standard Electrical Works.
Standard Undergrnd Cable Co.
Sterling Electric Co.
Thomas Insulator Co.
Western Electric Co.

Lamps, Arc
Benjamin Electric Mfg. Co.
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Incandescent
Bryan, Marsh Co.
Electric Appliance Co.
California Incand. Lamp Co.
Holabird-Reynolds Elec. Co.
Johns-Manville Co., H. W.
General Electric Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.

Line Material
General Electric Co.
Johns-Manville Co., H. W.
Standard Electrical Works.

Meters, Electric
Duncan Elec. Mfg. Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
B. F. Kieruliff, Jr. & Co.
Standard Electrical Works.
Westinghouse Elec. & Mfg. Co.

Meters, Gas
Pacific Meter Co.

Mining Machinery
Moore, Chas. C. Co., Inc.

Motors
Century Electric Co.
Crocker-Wheeler Co.
Electric Appliance Co.
Fort Wayne Electrical Works
General Electric Co.
B. F. Kieruliff, Jr. & Co.
Northern Electric Mfg. Co.
Pierson, Roeding & Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.

Nipples
Chase-Shawmut Co.

Outlet Blocks
Chase-Shawmut Co.

Outlet Bushings and Locknuts.
Chase-Shawmut Co.

Paint, Insulating
Paraffine Paint Co.
Standard Electrical Works.

Pins
Benicia Iron Works

Pipe
Pierson, Roeding & Co.
Schaw-Batcher Co., The

Pipe and Boiler Coverings
Johns-Manville Co., H. W.

Poles, Ties, Brackets, etc.
B. F. Kieruliff, Jr. & Co.
Barnes-Lindsley Mfg. Co.

Pole Lines
Pierson, Roeding & Co.
Benicia Iron Works.

Power Plants
General Electric Co.
Moore & Co., Chas. C., Inc.
Standard Electrical Works.
Tracy Engineering Co.

Pumping Machinery
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.

Pumps, Centrifugal
Moore, C. C. & Co., Inc.

Pumps—Air Lift and Artesian
Hunt, Mirk & Co.

Pumps, Steam
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.

Rail Bonds
Chase-Shawmut Co.
B. F. Kieruliff, Jr. & Co.
Pierson, Roeding & Co.

Solder Paste.
Chase-Shawmut Co.
Standard Electrical Works.

Steam Engines
Tracy Engineering Co.

Stage Lighting Fittings.
Chase-Shawmut Co.

Steam Plant Equipment
Tracy Engineering Co.

Steam Boilers
Moore & Co., Chas. C., Inc.
Standard Electrical Works.
Tracy Engineering Co.

Steam Packing
Johns-Manville Co., H. W.

Storage Batteries
Electric Storage Battery Co.

Switch Boxes
Electric Appliance Co.
Standard Electrical Works.

Switches
Bossert Elec. Cons. Co.
Electric Appliance Co.
General Electric Co.
B. F. Kieruliff, Jr. & Co.
Standard Electrical Works
Westinghouse Elec. & Mfg. Co.
Sterling Electric Co.
Western Electric Co.

Tape
Electric Appliance Co.
General Electric Co.
B. F. Kieruliff, Jr. & Co.
Okonite Co., Ltd.
Standard Electrical Works
H. W. Johns-Manville Co.

Telegraph Apparatus
Sterling Electric Co.

Telephones and Supplies
Brooks-Follis Elec. Corp.
Electric Appliance Co.
B. F. Kieruliff, Jr. & Co.
Sterling Electric Co.
Standard Electrical Works
Western Electric Co.

Tested Fuse Wire and Links.
Chase-Shawmut Co.
Standard Electrical Works.

Test Lamps, Pocket
Chase-Shawmut Co.

Transformers
Crocker-Wheeler Co.
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Standard Electrical Works
Westinghouse Elec. & Mfg. Co.
Sterling Electric Co
Western Electric Co.

Traps, Steam
Moore, Chas. C. Co., Inc.

Valves
Moore & Co., Chas. C., Inc.
Standard Elec. Works

Water Wheels
Pelton Water Wheel Co.
Moore, C. C. & Co., Inc.

Water Wheel Governors
Pelton Water Wheel Co.
Pierson, Roeding & Co.

Wires and Cables
Electric Appliance Co.
General Electric Co.
Habirshaw Wire Co.
Indiana Rubber & Insulated Wire Co.
B. F. Kieruliff, Jr. & Co.
New York Insulated Wire Co.
Okonite Co., Ltd.
Nat. Conduit & Cable Co., The
Simplex Electrical Co., The
Sterling Electric Co.
Standard Electrical Works.
Standard Undergrnd. Cable Co.
Western Electric Co.